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## A NEW SPECIES OF TREMATODE FROM THE PAINTED TERRAPIN, *CHRYSSEMYS* *MARGINATA* AGASSIZ

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### *Synopsis*

	PAGE.
Introduction .....	193
Technique .....	194
Morphology of Trematode .....	198
Taxonomy .....	207
Comparative Table of the Species in the Genus <i>Telorchis</i> .	
Papers Cited .....	217
Explanation of Plate .....	218

### INTRODUCTION<sup>1</sup>

A large number of investigators have from time to time contributed to our knowledge of the parasites of turtles. Among these contributions the classical work of Looss, *Ueber neue und bekannte Trematoden aus Seeschild-Kröten*, stands out pre-eminently and will for a long time to come be the model to which other investigators will conform and which will stimulate the investigations in parasitology in all countries.

<sup>1</sup> It is fitting that I should state that Mr. Covey is entitled to the credit for having done the major part of the work in this investigation. The work was done under my direction and I have carefully gone over all of the data and have studied the material used in this investigation and can vouch for its accuracy. F. D. B.

As in other phases of parasitology more has been done on the parasites of turtles in Europe than in the United States and Canada. For this reason and at the suggestion of Professor Barker I began this investigation of the parasites of the painted terrapin, *Chrysemys marginata* Agassiz.

#### TECHNIQUE

In the fall of 1911, sixteen turtles were secured from Lake Emily, a small lake near St. Peter, Minnesota. These turtles furnished the parasitic material for this study. The alimentary tract exclusive of the esophagus, the urinary bladder, the lungs and the liver were the organs to which special attention was given, and all were found to harbor parasites with the exception of the liver. The stomach and intestine were opened from end to end and allowed to lie in normal salt solution from five to ten minutes, in which time most of the trematodes loosened their hold and fell to the bottom of the dish. The others, which were too small to be seen on the surface of the intestine, were removed by gently stripping the intestine from end to end between the thumb and forefinger. The nematodes were easily seen and removed with a pipette or small forceps. The intestines and stomachs of turtles number V, VII and IX were negative with respect to trematodes, while nematodes were invariably present in the pyloric end of the stomach or the duodenum or both.

In examining the liver, the gall-bladder was first opened and carefully inspected, but in no case contained parasites. The bile ducts were so small that they could be examined only by teasing the organ into fine pieces, thus producing a large amount of sediment which was difficult to get rid of, but no trematodes were found.

In no case did the urinary bladder contain more than one trematode which was of a large type, distinct from those found in the intestine, but resembling, superficially at least, those found in the lung. The bladders were negative except those of turtles Nos. II, III, IX, X and XIII. The lungs were all negative except those of turtle No. V, from which four trematodes were obtained.

In all ninety-three trematodes were obtained of which five were from the urinary bladder, four were from the lungs and eighty-four were from the intestine; one hundred and seventeen nematodes, all from the stomach and duodenum, were obtained. Of the eighty-four trematodes from the alimentary canal, eighty-two were of one type and the other two were of two different species, though one of these closely resembles the first type. In all, five species of trematodes were found in the turtles, and will be designated as types *A*, *B*, *C*, *D* and *E*. The nematodes were apparently of one type. It is of interest to note the entire absence of cestodes in these turtles.

The table on page 196 shows the class of parasite found, the organ infected and the degree of infection for each turtle.

It will be seen from the table that, with one exception, all of the turtles harbored parasites which were evenly divided between the trematodes and the nematodes. Of the trematodes, type *A* predominated, being found in twelve out of the sixteen turtles examined. The largest number of parasites found in any one turtle was twenty-three, three turtles having this number. Turtle number VI harbored the greatest number of trematodes, namely twenty-two, all of the same type.

The nematodes were killed by dousing them quickly with cold lacto-phenol solution in which they were allowed to remain indefinitely, or killed in Zenker's fluid and preserved in eighty-five per cent. (85 per cent.) alcohol. The trematodes were killed in three ways, as follows: by flattening between glass slides in Zenker's fluid, by dousing with Zenker's fluid and by dousing with lacto-phenol solution. About two thirds of them were killed by the first method, *i. e.*, flattening in Zenker's, to be used in making *toto* mounts. All the rest except one, were killed by dousing with Zenker's, to be used for making sections. One was killed in lacto-phenol solution with the purpose in mind of preserving the eggs in as nearly a normal condition as possible. Those killed in Zenker's were permitted to remain in this fluid for from twelve to twenty-four hours and were then treated with seventy per cent. (70 per cent.) iodized alcohol.

Twenty specimens were mounted *in toto*. These were stained

TABLE SHOWING DEGREE OF INFECTION

Turtle No.	Parasite	Type	No.	Organ Infected
I	Negative.			
II	Trematode.	A	11	Intestine.
	Trematode.	E	1	Bladder.
	Nematode.		4	Stomach.
III	Trematode.	A	14	Intestine.
	Trematode.	E	1	Bladder.
	Nematode.		4	Pyloric end of stomach.
	Nematode.		4	Duodenum.
IV	Trematode.	A	3	Duodenum.
	Nematode.		3	Duodenum.
V	Trematode.	D	4	Lung.
	Nematode.		2	Intestine.
VI	Trematode.	A	22	Intestine.
	Nematode.		1	Intestine.
VII	Nematode.		8	Intestine.
VIII	Trematode.	A	1	Intestine.
	Nematode.		2	Intestine.
IX	Trematode.	E	1	Bladder.
X	Trematode.	A	10	Intestine.
	Trematode.	E	1	Bladder.
	Nematode.		12	Intestine.
XI	Trematode.	A	2	Intestine.
	Nematode.		1	Intestine.
	Nematode.		8	Stomach.
XII	Trematode.	A	12	Intestine.
	Nematode.		11	Intestine.
XIII	Trematode.	A	1	Intestine.
	Trematode.	E	1	Bladder.
	Nematode.		10	Intestine.
XIV	Trematode.	A	3	Intestine.
	Trematode.	C	1	Intestine.
	Nematode.		6	Duodenum.
XV	Trematode.	A	2	Intestine.
	Nematode.		10	Duodenum.
XVI	Trematode.	A	1	Intestine.
	Trematode.	B	1	Intestine.
	Nematode.		6	Intestine.



SUMMARY OF TABLE

Number of turtles examined.....16

Parasites	Number	Organ
Trematode <i>A</i> .....	82	Intestine
Trematode <i>B</i> .....	1	Intestine
Trematode <i>C</i> .....	1	Intestine
Trematode <i>D</i> .....	4	Lung
Trematode <i>E</i> .....	5	Bladder
Total No. Trematodes .....	93	Intestine, lungs, bladder
Nematodes .....	92	Intestine and stomach

in three stains; some in borax-carmin, some in carmalum, and others in Delafield's haematoxylin. In staining, the regressive method of over-staining was always used, the material being left in the stain from twenty-four to forty-eight hours, then de-stained until well differentiated in seventy per cent. (70 per cent.) acid alcohol. In dehydrating, all specimens were permitted to remain in the higher alcohols (95 per cent. and 100 per cent.) for several hours. From one hundred per cent. (100 per cent.) alcohol they were placed in a mixture of one part absolute alcohol and one part cedar oil, in which they remained from two to four hours. They were then placed in a light clearing reagent consisting of a mixture of cedar oil and oil of bergamot for an equal length of time, then into a heavy cedar oil from twelve to twenty-four hours and mounted in thin balsam.

This procedure of changing gradually from a thin clearing to a heavy clearing reagent then to a light balsam was necessitated by a peculiar tendency on the part of these worms. At first an attempt was made to clear them in xylol but it was found that in a few hours they became perfectly opaque in the balsam. Then light oils such as bergamot and a mixture of cedar oil and oil of bergamot were tried but with the same result. I then tried placing them in half and half balsam and xylol, and permitting the xylol to evaporate, thus thickening the balsam, but this also proved a failure. Then, on trying the procedure just outlined the clearing was successful in a majority of cases, though a few have since become opaque. In experimenting thus, I observed a specimen while it was becoming opaque, and found that after

remaining in the balsam but a short time, an opaque streak appeared in the median line of the body, from the posterior end to the juncture of the middle and anterior thirds, at which point it branched into two streaks which in turn ended abruptly a little anterior to the ovary. This streak appeared instantly, as if a tube might have suddenly filled with some substance, or become emptied of some substance, having such a density or such a refractive index as compared with the balsam, as to clearly differentiate it. From this central streak there soon appeared branches radiating in all directions, and rebranching until they reached to the cuticle, and the whole worm became opaque. I decided that these streaks marked the outline of the excretory system, and later, in my study of cross, sagittal and frontal sections I corroborated this theory as will be shown in the description of the excretory system, given later.

In addition to the *toto* mounts, series of sagittal sections, series of cross-sections and series of frontal sections were made. All sections were stained in Delafield's haematoxylin.

As stated previously, three species of trematodes were found in the intestine. One of these species, when examined in a living state, showed the body to be covered with long spines but after staining and destaining in acid alcohol it was no longer possible to see these spines. The disappearance of the spines was undoubtedly due to the dissolving action of the acid alcohol. This clearly shows that the presence or absence of spines in stained and mounted specimens cannot be relied on as a differentiating character between species of trematodes.

This occurrence also emphasizes the value of the examination of specimens in a living condition or before treating them with acid reagents.

#### MORPHOLOGY OF *Telorchis (Protenes) leptus* N. SP.

I regret that lack of time prevented me from making a detailed study of all the parasites which were found in the turtles, but this will be done by other students in this laboratory. The trematode found in greatest numbers and designated as type *A* was studied in detail and the description of this form follows. The

description given is founded on a comparative study of thirteen mounted specimens and one live specimen.

These worms vary in length from 1.281 mm to 3.5 mm, the mode being 2.013 mm for 14.3 per cent. The width at the widest portion of the body varies between a minimum of 0.256 mm and a maximum of 0.458 mm the mode being 0.275 mm for 28.5 per cent. The widest part of the body is in the plane of the ventral sucker 0.591 mm posterior to the anterior end, or approximately at the boundary between the first and second fourths of the length of the body. From this point the outline of the body tapers toward both ends, but much more rapidly toward the posterior than toward the anterior end. The anterior end is, therefore, much more blunt and rounding than the posterior, which in some specimens is quite pointed (Plate I, fig. 8).

The cross-sections vary in form from the anterior end toward the posterior as follows: At the level of the posterior end of the esophagus the worm is very much flattened dorso-ventrally, the form of the section being a long narrow ellipse, and is arched so that the ventral surface is concave from side to side. The dimensions are 0.059 mm dorso-ventrally by 0.265 mm wide. From this point caudad to the center of the acetabulum the form changes to a more oval one, and the arch is lost, the ventral surface at this point becoming nearly as convex from side to side as the dorsal surface. Here the body is 0.118 mm dorso-ventrally by 0.236 mm wide. From the acetabulum to the ovary it becomes less and less flattened dorso-ventrally until at the ovary the dimensions are 0.189 mm by 0.264 mm. From here toward the posterior end, the first few sections again resume the long narrow elliptical form but not the arch, then they become very flat on the ventral surface and rounded on the dorsal surface giving somewhat the appearance of a semiellipse with the corners rounded. The dimensions remain very nearly the same as at the level of the posterior end of the esophagus back to the level of the testes. Here the sections become thicker dorso-ventrally but retain their flat ventral surface thus becoming nearly semi-circular in form. The dimensions at the level of the testes are 0.148 mm by 0.254 mm. Posterior to the testes the sections become less

and less flattened and continuously narrower until the posterior end is reached.

Very small spinelets are present deeply buried in the cuticula. The cuticula is raised about the base of each spinelet into a papilla-like structure, from the tip of which the spinelet projects. These papillae are arranged in regular order, in concentric circles about the oral sucker and in rows which check in all directions. They are very distinct at the anterior end, but toward the posterior end they become less and less distinct so that posterior to the middle of the body they can scarcely be discerned (Plate I, fig. 8).

The ventral sucker (Plate I, fig. 8) as previously stated is situated at the junction of the first and second fourths of the body or 0.640 mm from the anterior end, and in the mid-ventral line. It is somewhat smaller than the oral sucker. The maximum length and width is 0.106 mm, the minimum length is 0.059 mm and the minimum width is 0.079 mm. The mode for the length is 0.088 mm for 23 per cent. and the mode for the width, 0.106 mm for 23 per cent. From these dimensions it is seen that the shape of the ventral sucker varies in the different individuals, the variation depending largely, I believe, on the degree of contraction or relaxation of the animal when killed, as I have seen not only the ventral sucker, but also the oral sucker, and to a certain extent the internal organs change shape with the movements of the live animal. In eight of the fourteen examined, however, including the live specimen, the ventral sucker is circular in shape, the variations occurring in the other six. The variation in the sucker is always the same, *i. e.*, it becomes elliptical with its long axis in the transverse plane of the body of the worm (Plate I, figs. 1 and 8).

The subterminal oral sucker is slightly larger than the acetabulum and varies also in shape in the different individuals, being circular in only six out of the fourteen. The maximum measurements are: length 0.106 mm, width 0.145 mm; the minimum measurements are: length 0.059 mm, width 0.077 mm. The mode for the length is 0.106 mm for 38.4 per cent. and the mode for the width 0.106 mm for 30.9 per cent.

Posterior to the oral sucker and between it and the pharynx is

a cone-shaped structure with well-marked longitudinal muscle fibers which may be designated as a prepharynx. The small end of the cone connects with the mouth cavity and the large end with the pharynx (fig. 8).

The pharynx is highly muscular and somewhat unique in being formed of four muscular oval quadrants in place of the two bean-shaped halves which usually form the pharynx in the trematodes (fig. 8).

The maximum measurements of the pharynx are: length 0.065 mm, width 0.083 mm; the minimum: length 0.059 mm, width 0.047 mm. The mode for the length is 0.059 mm for 69.2 per cent. and the mode for the width 0.059 mm for 61.5 per cent. Following the pharynx is a short esophagus (fig. 8) having a maximum length of 0.207 mm, and a minimum length of 0.047 mm, the mode for the length being 0.089 mm for 16.7 per cent. At the end of the esophagus the digestive tract divides into two caeca which first run outward to approximately the junction of the lateral and second fourths of the width of the animal, then posteriorly and parallel with the lateral borders, thus dividing the body into a median and two lateral fields which contain certain definite organs as described later. The caeca always end posterior to the testes but at a very variable distance from the posterior end, the maximum distance being 0.236 mm, the minimum 0.077 mm and the mode being 0.118 mm and 0.236 mm for 16.7 per cent. In all but four specimens the two caeca were equal in length and in three of the four the right one was the longer (fig. 8).

The testes (fig. 8) lie in the posterior fifth of the body between the ends of the intestinal caeca, which, as stated above, always end posterior to them. The posterior testis is at a distance from the posterior end of the body varying between 0.154 mm and 0.512 mm with a mode of 0.236 mm for 16.6 per cent. They lie very close together one directly behind the other in the median line of the body. As a rule they are nearly spherical in shape, but on contraction of the body of the worm the transverse diameter may become much greater than the longitudinal diameter. In the fourteen specimens the testes of five were

approximately spherical, in three they were only slightly elongated transversely with reference to the long axis of the body, and in the remainder they were very much elongated transversely. The following are the measurements: maximum length 0.216 mm, width 0.366 mm; minimum length 0.059 mm, width 0.059 mm; mode for the length 0.118 mm, 0.106 mm and 0.089 mm for 15.3 per cent.; mode for the width 0.118 mm for 23.0 per cent.

The cirrus pouch (figs. 1 and 8) lies anterior to the acetabulum, *in no case reaching posterior to its posterior border*. Its base is always near the acetabulum, in nine of the fourteen lying over the center of it. In the other five, the base was slightly to the left of the acetabulum in one, to the right in three, and could not be distinctly seen in the fifth. From the base, the pouch extends in a twisted course cephalad and toward the left, passes ventral to the left caecum of the intestine, and ends in a genital papilla (figs. 1, 3 and 8) on the dorsal surface of the body at the level of the posterior end of the esophagus, approximately 0.045 mm from the left lateral border of the worm. The length of the cirrus pouch can only be approximated on account of its coiled course. It is about 0.413 mm long (average). The diameter of the pouch in cross-section at the base is 0.041 mm. From here it becomes gradually narrower and narrower, being 0.024 mm in diameter near the genital pore. At the base of and within the cirrus pouch is a large seminal vesicle (fig. 1). From the seminal vesicle a narrow tube, the *pars prostatica*, leads to the terminal portion or cirrus. The seminal vesicle and *pars prostatica* are surrounded by the cells of a well defined prostate gland which completely fills the basal portion of the cirrus pouch.

The ovary lies approximately at the junction of the first and second thirds of the body in the median longitudinal axis and is considerably smaller than the testes. It varies in shape from orbicular to oval and has a smooth margin. The length varies from 0.035 mm to 0.089 mm with a mode of 0.059 mm and 0.088 mm for 25 per cent.; the width varies from 0.041 mm to 0.089 mm, with a mode of 0.059 for 25 per cent.

Just posterior to the ovary, a little ventral to it, and slightly to the left of the mid-longitudinal axis, lies a rather large ovoidal



*receptaculum seminis* (figs. 5 and 8). Occupying the entire space between the two arms of the excretory bladder and lying posterior to the ovary and ventral to the *receptaculum seminis* is a glandular mass quite diffuse and without a limiting membrane. This is the shell-gland (figs. 5 and 8). Dorsal to the shell-gland and posterior to the ovary and *receptaculum seminis* lies the yolk reservoir, very close to the dorsal surface (figs. 5 and 8) with its two afferent or transverse vitelline ducts, one coming from either side, and its efferent duct leading to the ootype. Between the yolk reservoir and the *receptaculum seminis* on the left, is the proximal end of Laurer's canal (figs. 5 and 8). It extends anteriorly and to the left, and opens on the dorsal surface, generally at a point about midway between the ovary and the left caecum of the intestine, opposite the junction of the middle and posterior thirds of the ovary. In reaching this point it passes dorsal to the left branch of the excretory bladder and dorsal to the coil of the uterus.

From the ovary a short oviduct passes to the posterior and always has an enlargement about the size of an egg near its terminal end. This enlargement is possibly a *receptaculum ovorum* for the storage of eggs. At a point dorsal to the posterior portion of the receptaculum, between the yolk reservoir and the ovary, the oviduct joins a short duct from the *receptaculum seminis* and also one from the yolk reservoir. Laurer's canal also connects with these ducts at this point and the uterus begins here. This common point of meeting is surrounded by the diffuse shell-gland and constitutes the ootype.

The uterus is made up of numerous loose coils arranged in two lateral fields entirely distinct from each other except where the one joins the other just anterior to the anterior testis. These fields lie ventral and medial to the intestinal caeca, never extending over their outer borders, and ventral to the central reservoir of the excretory system. The coils pass toward the posterior on the right side, cross in front of the testes, never extending posterior to either of them, then pass cephalad on the left side. The terminal portion passes to the left of the ovary and acetabulum as

a straight tube. Just anterior to the acetabulum it turns slightly to the left and meets the cirrus pouch near its base. From this point it runs parallel and also posterior and ventral to the cirrus pouch and finally opens at the base of the genital papilla and internal to it (figs. 1, 3, 8).

The number of eggs varies from two to a very great number, being confined almost entirely to that portion of the uterus posterior to the ovary. The eggs are long ovals in shape with the opercular pole more flattened than the opposite pole. They have a well-marked operculum but are without filaments (fig. 6).

Their length varies from 0.053 mm to 0.040 mm. with a mode of 0.051 and 0.053 mm for 23 per cent.; their width varies from 0.020 mm to 0.026 mm with a mode of 0.023 mm for 53.9 per cent.

The yolk-glands are arranged in two lateral fields, outside the intestinal caeca, reaching from a point just posterior to the ovary to a point just a little anterior to the anterior testis. The right gland is always a little shorter than the left. The acini are not arranged in definite groups, but are more or less irregular. The vitelline ducts pass medially dorsal to the intestinal caeca to reach the yolk reservoir (fig. 8).

The excretory system consists of a large median reservoir, which begins slightly posterior to the ovary and extends to the anterior testis, lying between the two intestinal caeca and dorsal to the uterus. The median reservoir branches just posterior to the ovary into two tubes, one of which passes forward on either side of the ovary and both of which end just a little anterior to it. The left branch is usually a little longer than the right. From the median bladder very small lateral branches are given off, which radiate in all directions, branching and re-branching until they reach the cuticula. At the anterior testis the central bladder becomes contracted into a duct, which passes dorsal to the testes, as may be seen in both sagittal and cross-sections. Posterior to the testes it becomes again distended into a second bladder, which opens to the exterior through the excretory pore at the extreme posterior end of the body (fig. 8).



TABLE OF SPECIFIC CHARACTERS OF *Telorchis leptus* N. SP.

	Maximum	Minimum	Mode	Per Cent. Mode
Size.....	3.500 mm	1.281 mm	2.013 mm	14.2
Oral sucker.....	0.458 mm	0.256 mm	0.275 mm	28.5
Ventral sucker.....	0.106 mm	0.059 mm	0.106 mm	38.4
	0.145 mm	0.077 mm	0.106 mm	30.9
	0.106 mm	0.059 mm	0.088 mm	23.0
	0.106 mm	0.079 mm	0.106 mm	23.0
Distance from anterior end	1.000 mm	0.275 mm	0.640 mm	25.0
Pharynx.....	0.065 mm	0.059 mm	0.059 mm	69.2
Pre-pharynx.....	0.083 mm	0.047 mm	0.059 mm	61.5
Esophagus.....	Cone		Cone	100.00
Intestinal caeca.....	0.207 mm	0.047 mm	0.089 mm	16.7
	0.236 mm	0.077 mm	0.236 mm	16.7
Caeca.....	right longer	left longer	0.118 mm	
Cirrus pouch.....	over center of acetabulum	to the left of acetabulum	equal over center of acetabulum	66.6
	0.457 mm	0.354 mm	0.413 mm	69.2
	0.089 mm	0.035 mm	0.421 mm	23.0
	0.089 mm	0.041 mm	0.059 mm	25.0
Ovary.....	in first third of body	in second third of body	0.059 mm	25.0
		at junction of 1st and 2d thirds		88.8

	Maximum	Minimum	Mode	Per Cent. Mode
Testes.....				
Length	0.216 mm	0.059 mm	{ 0.118 mm 0.106 mm 0.089 mm	15.3
Width	0.366 mm	0.059 mm	0.118 mm	23.0
Shape	spherical	oval	spherical; elongated transversely	41.6
Distance of post. testes from post. end				
Length	0.512 mm	0.154 mm	0.236 mm	16.6
Width	0.953 mm	0.040 mm	{ 0.051 mm 0.053 mm	23.0
In two lateral areas which do not cross. Descends on right side, crosses anterior to testes, and ascends on left side.	0.026 mm	0.020 mm	0.023 mm	53.9
Passes to left of ovary and acetabulum, to left and ventral, and parallel to cirrus pouch, and opens at the base of the genital papilla.				100.0
Far removed to left, on level with posterior end of esophagus, on dorsal surface of body, very near to left margin of body.				100.0
Position and extent				100.0
Y-shaped vesicle. Branches just posterior to ovary. Passes dorsal to testes.				100.0
Widest at plane of acetabulum, tapers both ways. Posterior end pointed. Anterior end rounded. Body flat.				100.0
Present. Arranged concentrically about oral sucker. Become fewer toward post. end. Not seen post. to level of ovary.				59.0
Spines.....				100.0

## CLASSIFICATION

Lühe (1899: 524) has described a genus of trematodes which he calls *Telorchis* with reference to the position of the testes which are situated in the extreme posterior end of the body and separated from the ovary by a great distance, using as a type-species *Telorchis clava* Dies. The following is his description in part:

“Aehnliche Lagerungsverhältnisse der Genitalorgane finden sich unter den bisher beschriebenen Distomen bei *Dist. Poirieri* Stoss. (= *Dist. gelatinosum* Poirier nec Rud.), *Dist. Linstowi* Stoss. (= *Monostomum aculeatum* Linst.), *Dist. Ercolanii* Montic. (= *Dist. signatum* Ercol. nec Duj.), *Dist. nematoides* Mühl., sämmtlich aus Reptilien. Alle diesen Arten stimmen darin überein, dass die beiden Hoden median hinter einander am Hinterende des Thieres liegen, der Cirrusbeutel sich durch ein auffällige Länge auszeichnet und vor dem Bauchsaugnapf, etwas nach links verschoben, ausmündet, dass ferner das Ovarium unmittelbar hinter dem Hinterende des Cirrusbeutels liegt, von den Hoden durch die Hauptmasse des stark entwickelten Uterus getrennt, während die Dotterstöcke mit ihren zahlreichen Follikeln die Seiten des Körpers erfüllen, sich dem Vorder- und Hinterende des Thieres mehr oder weniger weit nährend. Aller Arten besitzen ferner bis an's Hinterende ziehende Darmschenkel und sind (mit Ausnahme von *Dist. Poirieri*) am Vorderkörper bestachelt; so weit Angaben über das Excretionsgefäßsystem vorliegen, zeichnet sich die Excretionsblase durch ihre langgestreckte Gestalt aus; in Folge der Gabelung am Vorderende erscheint sie einem Y vergleichbar. In der Regel ist auch der Mundsaugnapf etwas grösser als der Bauchsaugnapf, nur bei *Dist. Ercolanii* Montic. sollen beide ungefähr gleich gross sein. Diese weitgehende Übereinstimmung berechtigt uns dazu, die genannten Distomen in einer besonderen Gruppe von Gattungswerth zu vereinigen, für welche ich mit Rücksicht auf die Lage der Hoden den Namen *Telorchis* vorschlage. Als typische Art der neuen Gattung sehe ich *Telorchis clava* (Dies.) an.

“In diese Gattung gehören ausser den schon genannten Arten noch *Dist. bifurcum* Braun und *pleroticum* Braun. . . .”

Looss (1899: 566) also describes the genus *Telorchis* as follows:

“Körper in die Länge gestreckt und nach vorn mehr oder minder stark verjüngt; Haut mit Stacheln bewaffnet oder glatt (?). Darm mit Pharynx, kurzem Oesophagus und bis ins Hinterende reichenden Schenkeln. Excretionsblase? Genitalöffnung vor dem Bauchsaugnapf, Begattungsorgane vorhanden, stark in die Länge gestreckt und weit nach hinten reichend. Hoden im Körperende hinter einander, Keimstock weit von ihnen

entfernt, etwas seitlich, in der Nähe des Endes des Cirrusbeutels gelegen. Laurer'scher Canal vorhanden, Receptaculum seminis? Dotterstöcke mässig entwickelt, ausserhalb der Darmschenkel. Uterusschlingen die Darmschenkel nach aussen nicht überschreitend, und von dem vordern Hoden bis ungefähr zur Mitte des Cirrusbeutels reichend; mässig dicht. Eier in der Länge um 0.03 mm., in der Breite um 0.018 mm. schwankend.

“Zum Typus dieser Gattung erkenne ich *Telorchis linstowi* Stossich. Die meines Wissens erste und gute Abbildung einer hierher gehörigen Form ist von Monticelli gegeben worden (*Distomum ercolanii* Montic.), und deshalb hätte eigentlich diese Art das erste Anrecht darauf, als Typus bezeichnet zu werden. Indessen bin ich nicht ganz sicher, ob *Dist. ercolanii* Mont. nicht vielleicht mit *Dist. linstowi* Stoss. identisch ist. . . .

“Zu dem Genus *Telorchis* dürften ferner zu rechnen sein: *D. poirieri* Stoss. (wenn es sich als selbständige Form erweist), *D. nematoides* Mühlhng und die Art, die Molin und Stossich als *Dist. arrectum* Dujardin beschreiben. . . .”

Braun (1901: 13), in summarizing the descriptions of Lühe and Looss, says:

“Luhe's Arbeit ging von dem kaum mehr als dem Namen nach bekannten *Dist. clava* Dies. (1850) aus, das den Darm von *Eunectes scytale* bewohnt; es wurde festgestellt, dass die in der Mittellinie liegenden Geschlechtsdrüsen derart angeordnet sind, dass der Keimstock weit vorn, dicht hinter dem Bauchsaugnapf, und die Hoden ganz hinten und zwar hintereinander gelegen sind, sowie dass zwischen Keimstock und den Hoden der ganze Uterus sich einschiebt. Wegen der endständigen Lage der Hoden erhielt die Gattung ihren Namen; ihr Typus wurde *Dist. clava* Dies. Weitere Angehörige seien *Dist. Poirieri* Stoss. (= *Dist. gelatinosum* Poir. nec Rud.), *D. Linstowi* Stoss. (= *Monostomum aculeatum* Linst.), *D. Ercolanii* Montic. (= *D. signatum* Ercol. nec Duj.), *D. nematoides* Mühl. und zwei neue von mir beschriebene Arten: *Dist. bifurcum* und *D. pleroticum*; möglicherweise gehört auch noch *Dist. arrectum* Mol. (nec Duj.) zu derselben auf Reptilien beschränkten Gattung.

“Looss basiert dagegen *Telorchis* auf *Dist. Linstowi* Stoss. (= *Monst. aculeatum* v. Linstow.) und rechnet zu ihr dieselben Arten wie Lühe, von *D. bifurcum* und *D. pleroticum* abgesehen, von deren Existenz Looss nichts wissen konnte. Beide Autoren hegen übrigens über die Berechtigung einiger Arten Zweifel; für Lühe is *Dist. nematoides* Mühl. möglicherweise, für Looss zweifellos identisch mit *D. Ercolanii* Mont. und dieses wieder fällt nach Looss vielleicht mit *D. Linstowi* Stoss. zusammen, möglicherweise hiermit auch *D. Poirieri* Stoss.”

From the description previously given of the trematode found

in the painted terrapin it will be seen that it conforms to Lühe's genus *Telorchis* in the following points: both testes lie, one behind the other, in the median line, at the posterior end of the body; the cirrus pouch is long and has its opening anterior to the ventral sucker and removed more or less to the left; the ovary lies in the same relative position in the body; the ovary is separated from the testes by the mass of greatly coiled uterus, all of which lies in this position, in no case extending posterior to the anterior testis; the yolk-glands with their many follicles fill the sides of the body "sich dem Vorder- und Hinterende des Thieres mehr oder weniger weit nähernd"; it possesses intestinal caeca which reach to the posterior end; the excretory system forks just posterior to the ovary, thus becoming Y-shaped; and the acetabulum is slightly smaller than the oral sucker.

Looss describes the genus *Telorchis* as being either armed or unarmed ("Haut mit Stacheln bewaffnet oder glatt (?)") and he also describes the cirrus pouch as extending posterior to the acetabulum as far as the ovary. He mentions, in addition, the presence of the following organs: a pharynx, short esophagus, Laurer's canal, and a *receptaculum seminis*. All of these organs are present in my specimens. From this comparative study it is evident that the trematode which I have described conforms to the descriptions of both Lühe and Looss of the genus *Telorchis* and should be placed in that genus.

There is however one marked and important variation, in the form which I have described, from the descriptions of the genus *Telorchis* as given both by Lühe and Looss. This is the position of the cirrus pouch which in my specimens never extends posterior to the acetabulum and consequently also the position of the genital pore which is on the dorsal surface, far anterior and to the extreme left of the acetabulum.

These differences will be considered more fully a little later in the discussion.

Lühe (1899: 529) in his description of *T. clava*, says:

"Die grösste anatomische Differenz, welche sich innerhalb der Gattung findet, betrifft den Oesophagus, welcher bei *T. clava* (Dies.) vollständig fehlt, bei *T. nematoides* (Mühl.) dagegen sogar recht lang ist. Diese

Differenz dürfte in Zusammenhang stehen mit der gedrungenen Körperform von *T. clava*, kann jedoch gegen die Einheitlichkeit des Genus ebensowenig geltend gemacht werden, wie etwa die verschiedene Lage des Excretionsporus innerhalb der Gattung *Opisthorchis*."

Again Lühe (1900: 566) says:

"Schon bei meiner vorläufigen Beschreibung der Art [*T. clava*] habe ich darauf hingewiesen, dass dieselbe sich von den übrigen *Telorchis*-arten etwas unterscheide. Sie ist gedrungener gebaut und wohl im Zusammenhange damit steht das Fehlen des Oesophagus. Noch weniger Wert wie auf diesen Unterschied glaubte ich darauf legen zu dürfen, dass der Uterus etwas stärker gewunden ist; ich habe deshalb letzteres auch gar nicht besonders hervorgehoben, obwohl es aus meiner Beschreibung selbst hervorgeht.

"Looss legt nun gerade auf die Windungen des Uterus grosses Gewicht, ob mit Recht, dürfte vielleicht noch der Prüfung bedürfen. In der angegebenen Diagnose der Gattung *Telorchis* Lss. steht ausdrücklich: 'Uterusschlingen die Darmschenkel nach aussen nicht überschreitend.' Dies trifft für *Distomum clava* nicht zu. Dort liegen Uterusschlingen auch noch marginal vom Darm und auf Querschnitten zwischen Keimstock und vorderem Hoden umkreist der von den Uterusschlingen eingenommene Raum die beiden Darmschenkel in Form einer 8.

"Ich halte auch heute noch diese verhältnismässig geringfügigen Abweichungen nicht für ausreichend, um einen Einwand gegen die Natürlichkeit der Gattung *Telorchis* in meinem Sinne bilden zu können. Ich sehe mich aber durch die systematische Arbeit von Looss genötigt, darauf hinzuweisen, dass es eventuell möglich wäre, die Gattung *Telorchis* Lhe. (nec Lss.) in zwei Untergattungen zu zerlegen: *Telorchis* Lhe. (nec Lss.) s. str. mit *Tel. clava* als einziger Art und *Cercorchis* n. subg. (= *Telorchis* Lss. nec (Lhe.) mit *Tel. (Cerc) Linstowi* (Stoss.) als typischer Art."

The absence or presence of an esophagus, then, is the main feature upon which Lühe bases his division of the genus into two subgenera, *Telorchis*, in which the esophagus is absent with *T. clava* as a type and *Cercorchis* which has an esophagus with *T. (Cerc.) Linstowi* as the type. Another feature which he considers of minor importance is the manner of the coiling of the uterus, and the relation of the coils to the intestinal caeca, in the subgenus *Telorchis* the coils not being confined within the space between the lateral borders of the caeca, while in the subgenus *Cercorchis* they are thus confined. In both subgenera the other organs have practically the same relationship to each other. It is



evident, therefore, that with respect to the presence of an esophagus and the lateral extent of the uterus the form which I have described belongs to the new subgenus *Cercorchis* of which *T. Linstowi* Stoss. is the type species.

A study of the comparative table of the species described for the genus *Telorchis*, with the exception of *T. angustum* Staff., from the intestine of *Chrysemys picta*, shows that the cirrus pouch always extends rather far posterior to the acetabulum with its base lying either beneath or very near the ovary and that the genital pore, though slightly removed to the left in most cases, is relatively near the anterior edge of the ventral sucker. It will, furthermore, be noticed that in my specimens and in *T. angustum* Staff. (Pl. I, figs. 2 and 8) the base of the cirrus pouch never lies posterior to the posterior edge of the acetabulum and often lies anterior to its anterior edge, being separated from the ovary by a distance of 0.458 mm and the genital pore is removed to the extreme left and relatively far anterior, so that the cirrus pouch and vagina pass ventral to the left caecum to reach it.

If Lühe has sufficient grounds for dividing the genus *Telorchis* into the two subgenera *Telorchis* and *Cercorchis* on the presence or absence of an esophagus and the extent of the uterine coils, it seems to me that the marked difference in the position of the cirrus pouch and the genital pore in *T. angustum* Staff. and my form, characters which both Looss and Lühe recognize as of generic value, constitutes an important morphological difference and warrants the creation at least of a separate subgenus if not a separate genus. The position of the cirrus pouch, always anterior to the acetabulum, being a distinctive character I therefore suggest the name *Protenes* as an appropriate one for such a subgenus with *Telorchis (Protenes) leptus* n. sp. as the type species. This new subgenus would contain the two species *T. leptus* n. sp. and *T. angustum* Staff.

In making a comparative study of the species in the genus *Telorchis* I noted what appears to me to be an error on the part of Braun, either in his description or in the classification of his species *T. pleroticus* and *T. bifurcus*, for in describing them he says (Braun, 1901: 13):

“Wegen gewisser Unterschiede zwischen *Dist. clava* Dies. und den übrigen zu *Telorchis* gerechneten Arten hat Lühe (Einig. Dist. aus Schlang. und Eidechsen, in Centralbl. f. Bakt. etc. [I] XXVIII, 1900, p. 566) die Gattung *Telorchis* in zwei Untergattungen geteilt; die eine mit *Dist. clava* als Typus behält den Namen *Telorchis*, die andere mit *D. Linstowi* (Stoss.) als Typus wird *Cercorchis* genannt. Die hier beschriebenen *Telorchis*-arten gehören alle der Untergattung *Cercorchis* an.” The “hier beschriebenen *Telorchis*-arten” referred to include the following: *T. aculeatus* (= *T. Linstowi*), *T. pleroticus* (Brn.), *T. bifurcus* (Brn.) and *T. parvus* (Brn.). It will be remembered that according to Lühe’s classification, as quoted above, the presence or absence of an esophagus is the principal differentiating character which separates the subgenera *Telorchis* and *Cercorchis*.

In describing *T. pleroticus* (Brn.) Braun (1901: 17) says:

“Im Gegensatz zu den bisher bekannten Arten liegt der 0.13 mm breite, ellipsoide Pharynx nicht unmittelbar hinter dem Mundsaugnapf, sondern *dicht vor der Gabelstelle des Darms*; der damit entstehende Praepharynx ist 0.12–0.17 mm lang. Die Darmschenkel ziehen den Körperändern sehr genähert bis fast an den Hinterrand und überragen die Hoden um eine bis zwei Hodenlängen.” And again (1901: 18) in describing *T. bifurcus* (Brn.) he says:

“Wie bei *T. pleroticus* kommt auch hier ein Praepharynx (0.42–0.47 mm lang) vor und der etwa kuglige Pharynx (0.16–0.18 mm lang, 0.18–0.21 mm breit) *sitzt dicht vor der Gabelstelle des Darms*.” The two statements are confirmed in his drawings, figs. 5 and 2, plate I, of the same paper, both showing the pharynx “dicht vor der Gabelstelle des Darms.” In neither case does he mention the presence or absence of an esophagus, which appears both from his description and drawings to be absent. Even though the coils of the uterus are confined between the caeca, this as Lühe says, is a minor character and “Die grösste anatomische Differenz, welche sich innerhalb der Gattung findet, betrifft den Oesophagus, welche bei *T. clava* (Dies.) vollständig fehlt, bei *T. nematoides* (Mühl) dagegen sogar recht lang ist.” Therefore, if, as Braun’s drawings indicate, “Dicht vor” means that the phar-



ynx is *immediately before* the division of the intestine and therefore that no esophagus exists, to be consistent with these facts, it seems to me that Braun should have placed *T. pleroticus* (Brn.) and *T. bifurcus* (Brn.) in the subgenus *Telorchis* instead of in the subgenus *Cercorchis*.

As previously stated the form which I have described differs from all the species included in the subgenera *Telorchis* and *Cercorchis* in the position of the cirrus pouch and genital pore with the exception of *T. angustum* Stafford and it only remains to determine whether or not it is identical with *T. angustum* (Stafford). The following is Stafford's description (1900: 407) and his correction (1905: 690) quoted in full:

"The worm here referred to I found in the intestine of the Painted Turtle (*Chrysemys picta*). It is a long, narrow (*angustum*), very thin animal. Its length, when mounted, is 3.150 mm, its breadth 0.455 mm. The anterior sucker measures 0.125 mm; the posterior, ventral sucker 0.095 mm broad, is situated 0.875 mm farther back.

"The pharynx, 0.075 mm long, is situated 0.050 mm from the mouth-sucker, and there is another, longer, constricted, piece, the esophagus, 0.225 mm between it and the forking of the intestine. The latter is very like the corresponding part in the preceding species [*Dist. chelydrae* n. sp.] parasitic in the Snapping Turtle.

"The unpaired part of the excretory system branches, I think, at the posterior testis.

"The testes are found, one behind the other, between the ends of the intestinal caeca, and the duct from the anterior one is turned to the right side. The penis is a long narrow organ (length 0.5 mm), lying obliquely across the left caecum, with its base to the right of the ventral sucker and its apex opening on the ventral surface, near the left margin, a little posterior to the line traversing the forking of the intestine. There is a penis sack containing a vesicula seminalis and the end of the intromittent organ is, in the mounted specimen I am describing, exerted from the genital pore and bent back under the body. The ovary lies behind the ventral sucker, a little in front of the middle of the body and between two enlarged lateral vessels of the excretory system. Behind it is the yolk reservoir with the transverse vitelline ducts. The anterior end of the oviduct—the vagina—lies on the opposite side of the ventral sucker from the penis-sack and opens with the latter at the genital pore. Eggs occupy the body from the sucker to the anterior testis but chiefly behind the ovary and between the intestines. The vitelline glands lie between the

intestines and the body walls, extending from the region of the genital pore to near the anterior testis."

Correction (1905: 690):

"The position of the testes, ovary, uterus and vitellaria certainly entitle it to be considered with the *Telorchis* group. The long distance between ventral sucker and genital pore, but especially the position of the latter, are important differences. Upon renewed examination I am convinced that the penis-sac and vagina cross under the left coecum and open on the dorsal surface, and that the exserted penis lies above the body. There is a prepharynx. The vitellaria do not extend so far in front as I indicated in the drawing. The largest eggs measure  $0.042 \times 0.021$  mm."

On a whole Stafford's description and drawing (Pl. I, fig. 2) are a little meager and indefinite, but we can draw the following points of comparison from it. In the first place the host is *Chrysemys picta* while my form is from *Chrysemys marginata*. The position of the cirrus pouch and vagina and of the genital pore with their relations to the ventral sucker are practically identical with those of my specimens, which doubtless places them at least in the same subgenus. Other points of agreement are the position of the testes and their separation from the ovary by the mass of the uterus. As to the uterus nothing can be got from Stafford's description and drawing except its position between the caeca, and between the ovary and the anterior testis. In fact his drawing would seem to indicate that it was not arranged in two definite descending and ascending lateral fields as is that of my species. He says that the ovary is just "a little in front of the middle of the body. . . ." In my specimens it lies usually at or just a little posterior to the junction of the anterior and middle thirds of the body, bearing the same relation to the two branches of the excretory system that his does. According to his drawing the ovary in my species seems to have about the same relation to the acetabulum as in *T. angustum*, but both are placed farther forward, nearer the division point of the intestine. At first Stafford says the vitellaria extend from the region of the genital pore back to near the anterior testis, with which statement his drawing agrees; then he says, in his correction, "The vitellaria do not extend so far in front as I indicated in the drawing," but he

neglects to say just how far they do extend. In my specimens they never extend farther forward than the ovary.

The length of his specimen is 3.150 mm and the width 0.455 mm. Now, since it seems evident that his measurements are from a single specimen, they may be anywhere between a minimum and a maximum. Comparing this with mine, the mode for the length for my species is 2.013 mm, yet in four of the fourteen specimens compared the length exceeds 3.000 mm, and in two of the four it is greater than 3.150 mm. But in no one of these four does the width exceed 0.275 mm, which is a little more than half that of his specimen, and in only two of the other ten, which two are exceedingly contracted in length, thus increasing their width, does the width approach that named by Stafford, the width being 0.450 mm in one and 0.458 mm in the other. All other measurements given, such as that of suckers, esophagus and pharynx, are as much greater in his specimen than in mine as his specimen is larger than mine, though they have the same relative size as do mine.

By reference to Pl. I, figs. 2 and 8 it will be seen that my species is widest near the anterior end and that the posterior end is more pointed than the anterior, while *T. angustum* is widest some distance posterior to the ovary and the anterior end is relatively more pointed than the posterior, *i. e.*, the borders converge more rapidly toward the anterior.

As to the excretory system he says, "The unpaired part of the excretory system branches, I think, at the posterior testis." In my specimens it branches just posterior to the ovary, but Stafford could easily have been mistaken in this point, for only a few of all those which I mounted *in toto* showed the unpaired portion of the excretory system and it was only after making cross and sagittal sections that I could be certain of its position.

Neither in his descriptions nor in his drawing of the trematode which he found in the intestine of *Chrysemys picta* does Stafford indicate the presence of a Laurer's canal, a shell gland or a *receptaculum seminis*. Nor does he mention a seminal vesicle, *pars prostatica* or prostate gland in connection with the male genitals.

I have been able to identify and describe all of these structures in the trematode from the intestine of *Chrysemys marginata*.

In view of Stafford's meager description and his indefinite drawing and the differences already noted between *T. angustum* and the form which I have described, I am of the opinion that the two are not the same species and that the form found in *Chrysemys marginata* is a new species. If subsequent comparative study of the two forms bears out my conclusion I would suggest the name *Telorchis (Protenes) leptus*, as an appropriate one for the trematode which I have described as found in *Chrysemys marginata*.

#### DIAGNOSTIC CHARACTERS OF THE GENUS TELORCHIS

The following is a summary of the characters of the genus *Telorchis* based on the description of Looss (1899: 566), Lühe (1899: 524) and the present investigation.

Body elongate, more or less reduced toward posterior end, flat; skin armed or unarmed; testes, at posterior end of body, one behind the other in median line; cirrus pouch long, usually more or less coiled, contains seminal vesicle in posterior end, lies either wholly anterior to acetabulum, or extends posterior to it to region of ovary; genital pore dorsal or ventral, anterior to acetabulum and more or less removed to left of mid-line; ovary anterior to middle of body, in mid-line or slightly to one side, smaller than testes; yolk reservoir, *receptaculum seminis*, shell gland and Laurer's canal present in region of ovary; uterus long, coiled, filling space between ovary and testis and between caeca of intestine; oral sucker usually a little smaller than acetabulum; pharynx present; prepharynx present or absent; esophagus present or absent; long intestinal caeca extend almost to posterior end; yolk glands fill lateral areas from region of ovary to region of anterior testis; excretory system has a median dorsal vesicle which branches, at a point just posterior to the ovary into a Y-shape, and which opens through the excretory pore at the extreme posterior end.

*Habitat*.—Intestine of turtles, snakes and lizards.

#### KEY TO SUBGENERA OF GENUS TELORCHIS

- I. Cirrus pouch extends posterior to acetabulum.....II  
 A. Cirrus pouch does *not* extend posterior to acetabulum. *Protenes* n. s. g.  
 Type species.—*Telorchis leptus* n. sp. Barker and Covey.
- II. Esophagus absent .....III



COMPARATIVE TABLE OF THE SPECIES OF THE GENUS *TELORCHIS*

Species	<i>T. arrectum</i> (Molin)	<i>T. angustum</i> (Stafford)	<i>T. bifurcus</i> (Em.)	<i>T. elata</i> (Lühe). Type of subgen. <i>Telorchi</i>	<i>T. aculeatus</i> (v. Linstw.). Type of subgen. <i>Cercorchis</i>	<i>T. nematoides</i> (Mühl.)	<i>T. parvus</i> (Braun)	<i>T. poiretisi</i> (Stoss.)	<i>T. pleuroticus</i> (Bra.)	<i>T. setulosus</i> (Othner)	<i>T. leptus</i> (Barker and Covey)
Size	Length, 3.500 mm. Width, 1.000 mm.	Length, 3.150 mm. Width, 0.455 mm.	Length, 10.0-13.0 mm. Width, middle, 1.4-1.6 mm.; at acetab., 0.8-1.3 mm.; at pharynx, 0.5 mm.; between testes, 0.5-0.86 mm.	Length, 6.00 mm. Width, 1.2-2.3 mm. (at widest point).	Length, 5.0-7.0 mm. Width, 1.0 mm. (near ant. end); 0.5 mm. (near post. end).	Length, 3.03-4.13 mm. Width, 0.385 mm., widest part. Length: width :: 10 : 1.	Length, 2.00 mm. Width, 0.34 mm. (widest part).	Length, 1.10 mm. Width, 0.5 mm.	Length, 6-8 mm. Width, 0.26-0.39 mm.	Length, 7.5 mm. Width, 0.8-0.9 mm. at widest part.	Length 2.03 mm. Width 0.275 mm. (at widest part).
Shape	Body flat; long elliptical shape.	?	Long, flat, spindle-form; slightly bent to one side or C-shaped.	Widest near acetabulum, tapers both ways.	Borders converge posteriorly. Spindle-shaped.	Like a nematode.	Widest near anterior end; lateral margins converge backward from this point.	Ribbon-shaped (band-formig). Has a neck-part anteriorly (Braun). Flat. Rounded posterior end. White color (Stoss).	Long, flat; anterior and posterior ends rounded, and lateral borders straight; not quite parallel.	Long, flattened, maximum width in middle of body. Posterior 1/2 field containing uterus, body sharply reduced. At anterior end narrowing less marked. Anterior end rounded.	Elongated, narrow, widest just anterior to acetabulum. Tapers both ways, most rapidly posteriorly. Anterior end rounded. Posterior end more or less pointed.
Oral sucker	Anterior, subterminal; opening variable; slightly larger than acetabulum.	0.125 mm. in diam.	Nearly spherical; 0.20-0.25 wide; 0.18-0.24 long. At each side of anterior end is conical shaped appendage whose substance seems to be in continuation with the oral sucker.	Subterminal; 0.645 or 0.538 mm. diameter.	0.24 mm. in diam. (by Linstow); 0.16-0.18 mm. in diam. (by Braun).	Slightly oval, long axis in long axis of worm. Always larger than acetabulum, but relative size inconstant. Size, 0.1348 mm.	Circular; 0.059 mm., both diam.	0.14 mm. in diameter	Almost spherical; 0.227 mm. in diameter.	Sub-terminal; length, 0.19 mm., width, 0.2 mm.	Sub-terminal, circular. 0.106 mm. in both diameters.
Ventral sucker	Slightly smaller than oral sucker. In anterior third of body.	0.875 mm. from anterior end. 0.695 mm. in diam.	Nearly spherical; 2-3 mm. behind oral sucker. 0.21-0.25 mm. across. 0.22-0.27 mm. long.	At junction of first and second fourths; slightly smaller than oral sucker.	Approximately round. 1.00 mm. from anterior end. 0.13 mm.-0.16 mm. transverse diam.; 0.18 mm., long. diam.	Diam., 0.125 mm.	0.059 mm., trans. diam. 0.054 mm., long. diam.	Very small. 0.08 mm. in diameter. Situated anteriorly.	0.10-0.11 mm. in diameter. 1.0 mm. from oral sucker.	Round, 1.5 mm. from anterior end. Diameter, 0.28 mm. Larger than oral sucker.	0.640 mm. from anterior end. 0.106 mm. transverse diameter. 0.088 longest diameter.
Pharyngeal pouch or prepharynx	None	Present	Prepharynx, 0.42-0.47 mm.	Present	Absent	None	Absent	?	Prepharynx, 0.12-0.17 mm. long.	None	Present, muscular = prepharynx.
Pharynx	"Esophageal bulli" = Pharynx(?)	0.075 mm. long.	Nearly spherical, close anterior ( <i>right</i> view) to division of intestine.	0.376 mm. in transverse direction. 0.452 mm. in sagittal direction.	0.11 mm., transverse diameter; 0.08 mm.-0.11 mm., long. diameter.	Spherical. Diameter, 0.068 mm.	Oval in cross-section. 0.036 mm. in diameter.	Bulb very small.	Ellipsoidal—0.13 mm. wide; situated just before division place of the intestine.	Spherical; diameter, 0.146 mm.	0.059 mm. transverse diameter. 0.059 mm. longest diameter. 0.065(?) sagittal diam.
Esophagus	Following the "esophageal bulli" and is a "thin, short, pharynx"—the esophagus probably.	0.225 mm. long.	Absent (?)	Absent	Short, 0.13 mm.-0.17 long.	Thin. Length, 0.278 mm.	0.130 mm. long.	Short esophagus.	Absent (?)	Present. Length 0.35 mm.	Present 0.089 mm. long.
Intestine	Caeca first diverge, then coming larger extend to posterior end.	Two caeca, reach posterior to both testes.	Caeca rather wide—reach clear to esophagus, extend to posterior testis by one or two lengths of a testis.	Two caeca begin at pharynx and extend posterior between middle and lateral thirds to extreme posterior end of the body.	Two caeca begin at posterior end of esophagus, extend to posterior end of body. Relatively near mid-line, outside uterus and testes and inside yolk glands.	Caeca run clear back to posterior end. Slightly hidden by testes and vitellaria.	Caeca end on plane passing between the testes.	Caeca end on plane which passes between testes.	Run very close to edges of body; end posterior to testes.	Run near borders of body, internal to yolk glands, to extreme posterior end, where they end in same plane.	Two caeca, always reach posterior to both testes.
Ovary	Lies at side of part of cirrus pouch corresponding to sem. vesicle. Spherical; diam. = two-thirds that of testes.	Behind ventral sucker, a little anterior to the middle of the body.	Reniform; 0.36-0.46 mm. in cross-section.	Immediately posterior to posterior end of cirrus pouch, in middle line, nearly spherical, 2.0-2.4 mm. from anterior end, 0.16 mm.-0.18 mm. in diameter.	At posterior end of cirrus pouch, approx. in mid-line, nearly spherical, 2.0-2.4 mm. from anterior end, 0.16 mm.-0.18 mm. in diameter.	Spherical; diameter, 0.11-0.14 mm. lies over base of cirrus pouch at approximately the middle of the long axis of the body.	Spherical	Spherical	Spherical or elliptical, just behind posterior end of cirrus pouch. 0.16-0.21 mm. in diameter.	Under extreme posterior end of cirrus pouch, spherical; at left a little anterior to the middle of body. Diameter, 0.27 mm.	In mid-line, 0.150 mm. posterior to ventral sucker, nearly spherical, 0.088 mm. in diameter. At junction of first and second thirds of body.
Laurel's canal	?	?	?	?	?	?	?	?	?	?	Present, opening to left of ovary, between it and the medial boundary of the caecum of intestine.
Shell gland	?	?	?	Ventral and posterior to ovary.	?	?	?	?	?	?	Present, diffuse without definite limiting membrane; posterior and ventral to the ovary, receptaculum, and yolk reservoir.
Receptaculum seminis	?	?	Present; behind ovary.	Right and dorsal to shell gland.	?	?	?	?	?	?	Present, posterior ventral, and a little to left of ovary, and dorsal to a part of the shell gland.
Yolk reservoir	?	Just posterior to ovary.	?	?	?	?	?	?	?	?	Present, just posterior to ovary and dorsal to shell gland.
Uterus	Descending (left) and ascending (right) limbs; passes along right side of cirrus pouch to genital pore.	Passes left of acetabulum, opens at genital pore with penis, fills space between ovary and anterior testis (according to Stafford's drawing the uterus is not in definite lateral fields).	In descending and ascending limbs, which do not cross. Fills space between ovary and anterior testis.	Fills whole space between ventral sucker and posterior testis. Greatest between ovary and anterior testis. In two lateral fields. Terminal part passes left and ventral to cirrus pouch.	Between the caeca of intestines and between ovary and anterior testis. Right limb (descending) and left limb (ascending); do not cross each other.	Not in distinct ascending and descending fields, but coils superimposed and confused; fills whole space between caeca and between ovary and anterior testis. Terminal section S-form, reaches genital atrium.	Descending and ascending limbs do not cross each other.	Descending and ascending limbs of uterus cross each other (Braun).	Between ovary and anterior testis; right descending and left ascending fields. But there is more or less crossing making the fields indefinite.	In descending and ascending limbs, which cross each other, not remaining in their own lateral fields. The separation of the limbs of uterus is, hence, not so sharp as in some others. Anterior to acetabulum, always lie on left side and passes over to join cirrus pouch as rather thick vagina.	Fills space between caeca of intestines, and between ovary and anterior testis. Right descending, left ascending limbs. Terminal portion passes left of ovary and acetabulum, then follows cirrus pouch to base of genital papilla.
Testes	One behind the other, almost contiguous, in penultimate fifth of body; perfectly spherical; diameter half that of body.	In median line at posterior end, one behind the other.	Oval or elliptical, in usual position. Anterior one: length, 0.50-0.70 mm. Width, 0.40-0.70 mm. Posterior one: length, 0.60-0.86 mm. Width, 0.30-0.60 mm.	In median line, one posterior to the other. Anterior one spherical, 0.350 mm. X 0.45 mm. in diameter. (According to Braun anterior larger; both are elongated, 0.550 mm. long.	Equal, spherical or slightly elongated. 0.27 mm.-0.36 mm. in diameter. (According to Braun anterior larger; both are elongated.)	Far posterior; one directly behind other; spherical. Diameter, 0.16-0.21 mm.	Spherical at extreme posterior end.	Spherical and at extreme posterior end (Braun) ovoid. (Stoss). 0.114 mm. in diam.	Oval, 0.18-0.31 mm. long, 0.13-0.20 mm. wide. Behind each other in posterior end but separated by greater distance than usual length of testis.	Equal, irregularly round; lie flattened slightly against each other in extreme posterior end of body; separated from point by length of one testis. Length, 0.50 mm., width 0.42 mm.	Cannot be seen.
Vasa efferentia	Thin duct from superior vertex of testes, reaches to seminal vesicle which fills posterior one-third of cirrus pouch.	Right from anterior testis.	?	Left one from anterior testis, passes along inner border of caeca to point just anterior to ovary, then transversely to the sperm bladder.	?	Very long, running forward to unite to form vesicula seminalis in cirrus pouch.	?	?	?	?	Right one from anterior testis left from posterior; run along inner border of intestinal caeca.
Cirrus pouch	Cylindrical, about 4 times as great in diameter as spine-covered penis. Base at left side of ovary. It curves about acetabulum to reach the genital pore. Pouch about two-thirds as long as penis. Sigmoidal in form.	Penis 0.500 mm. long. Opens dorsally just posterior to line drawn transversely through forking of intestines. Contains vesicula seminalis.	Cylindrical; posterior end reaches to ovary, reach almost to anal testis; grouping in grape-like clusters may be indistinctly seen.	Very large, 1 mm. long, 0.48 mm. in cross-section. Greater part posterior to ventral sucker. Posterior part full of vesicula seminalis and prostate glands.	Elongated, club-shaped. 1.0 mm. or more long. Pouch mostly posterior to acetabulum. Vesicula seminalis lies in posterior end.	Uncommonly long, coiled. Length (without coils), 0.693 mm. Base beneath ovary, reaches forward to end at genital atrium just anterior and little to left of acetabulum.	Greatly elongated, cylindrical, contains small ves. seminalis. Extends back to touch or lie slightly beneath ovary.	Elongated, cylindrical, contains small vesicula seminalis; extends back to touch or lie slightly beneath ovary.	Elongated, yet shorter than in the other species, and posterior end is distended; reaches far posterior to acetabulum. The base lying near ovary.	Extremely long; from anterior edge of acetabulum it reaches back through one-third length of body = 2.4 mm. Coiled like a spring and of equal diameter (0.1 mm.) throughout, excepting a slight distension for sperm-bladder at posterior extremity.	Have to right of, or over center of acetabulum—never posterior to it. Approx. 0.413 mm. long; crosses to left and anteriorly, ventral to left caecum and opens on genital papilla.
Genital pore	Just anterior to acetabulum.	To left side, opens dorsally.	Just anterior to ventral sucker.	Anterior to ventral sucker, removed to left to line between middle and left lateral thirds of body.	Immediately anterior to ventral sucker (according to Linstow two pores are present side by side).	Just anterior and a little left of acetabulum.	Somewhat anterior to acetabulum and slightly removed to left.	Somewhat anterior to acetabulum and slightly to left (Braun).	Immediately anterior to anterior border of ventral sucker.	Very near left lateral border of body at level with posterior end of esophagus. Vas deferens opens on genital papilla, at base of which is opening of vagina; dorsal.	Two lateral fields outside caeca of intestine—reach from ovary to near anterior testis. Left is longer than right; acini not definite.
Vitelline glands	In lateral areas from genital pore to end of caeca. Surround middle of region of body like a belt, back to anterior testis. Formed by irregular little vesicles.	Lie between the intestine and body wall, from the genital pore, to near the anterior testis or pore, to the far forward.	In the lateral areas; begin posterior to ovary, reach almost to anterior testis; grouping in grape-like clusters may be indistinctly seen.	Dorso-lateral throughout full length of body. Overlie the intestine and folds of the uterus.	In lateral areas; 1.16 mm. long. Begin half way between ovary and acetabulum, and reach almost to anterior border of anterior testis. Made of rather confused grape-like clusters.	Lateral to caeca; 1.16 mm. long. Begin anterior to ovary and end anterior to testes (Braun). In grape-like clusters, only slightly developed (Stoss).	Middle third of lateral areas. Begin anterior to ovary and end anterior to testes (Braun).	Middle third of lateral areas. Begin posterior to ovary, reach almost to anterior testis. Are of equal length, or right is shorter. Follicles hide caeca of intestines.	In lateral areas outside caeca, begin one-third of distance from acetabulum to ovary behind the acetabulum, and end, the right a little anterior, the left a little posterior to a plane one half way from ovary to posterior end. Made up of follicles which are grouped very indefinitely in clusters.	Spines present.	Minute spines present.
Cuticula	Covered with spines which disappear posteriorly.	?	Spines present	0.012 mm. thick. Spines present	Spines present on cuticula.	Thin; armed with spines back to ovary. TL, 0.0396.	?	Spines absent	Spines present.	?	Uncommonly numerous. 0.03 mm. X 0.015 mm. Thin-shelled with lid. When newly made they are colorless, become golden-brown, and finally, at full development, dark-brown. Only ampulla-like bladder running dorsal to testes. Is to be seen.
Eggs	Small, of orange-yellow color.	0.021 mm. X 0.042 mm.	Numerous, thick-shelled. mm. X 0.014 mm.	0.021	Very numerous, 0.014 X 0.023 mm.	0.019 mm. wide. 0.016 mm. long.	Numbers; when new, golden yellow; when ripe, dark brown. 0.0334 mm. X 0.0194 mm.	0.028 mm. X 0.0409 mm.	0.018 mm. X 0.028 mm.	0.010 mm. X 0.020 mm. (Small).	0.023 X 0.051 mm. Lid present, no filaments.
Excretory system	Excretory pore large and in apex of tail.	Branches at posterior testis.	?	Bladder at posterior end passes dorsal to testes, stretched forward and forks into two branches.	Bladder posterior to testes.	?	Duct of ampulla-like bladder passes dorsal to testes in S-shape, so when distended it causes testes to lie obliquely.	Duct passes dorsal to testes (Braun).	?	Bladder, central, between caeca, extends from testes to ovary. Anteriorly it branches into two parts, one of which goes each side of ovary and ends blindly, making Y-shaped. Posteriorly it connects with a bladder running dorsal to the testes.	Present paper.
Host	<i>Pogoniscus muralis</i> and <i>Lacerta viridis</i> , green lizard.	<i>Chrysemys picta</i> , eastern painted turtle.	Turtle; museum specimens, therefore host not definite.	<i>Eunectes scytote</i> , snake.	<i>Testudo graeca</i> , tortoise.	<i>Tropidonotus natrix</i> , snake.	<i>Testudo orbicularis</i> , <i>Emys lataria</i> or <i>Cistudo lusaria</i> , box turtle.	<i>Emys lataria</i> or <i>Cistudo lusaria</i> , box turtle.	Turtle, museum specimens, therefore exact host not known.	River turtle, <i>Clemmys caspica</i> .	
Reference	Molin (1859: 831-33).	Stafford (1900: 407), (1905: 650).	Lühe (1899: 524).	Braun (1901: 14).	Mähling (1898: 18), (1898: 93-94).	Braun (1901: 19).	Stossich (1895: 27); Braun (1901: 17).	Othner (1901: 20).			

A. Esophagus present .....s. g. *Cercorchis* Lühe.  
Type species.—*Telorchis Linstowi* (Stoss.).

III. Esophagus absent .....s. g. *Telorchis* Lühe.  
Type species.—*Telorchis clava* Lühe.

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## EXPLANATION OF PLATE

All figures were made either with the *camera lucida* from original stained and mounted specimens or copied with a pantograph from the original drawings.

## Abbreviations

<i>ac.</i> , acetabulum,	<i>p.b.</i> , pharynx,
<i>c.</i> , cirrus,	<i>p.p.b.</i> , pre-pharynx,
<i>c.p.</i> , cirrus pouch,	<i>pr.g.</i> , prostate glands,
<i>cu.</i> , cuticula,	<i>p.p.</i> , pars prostatica,
<i>em.</i> , embryo,	<i>r.s.</i> , receptaculum seminis,
<i>es.</i> , esophagus,	<i>s.g.</i> , shell gland,
<i>ex.c.</i> , excretory canal,	<i>t.</i> , testis,
<i>ex.p.</i> , excretory pore,	<i>ut.</i> , uterus,
<i>g.p.</i> , genital pore,	<i>va.</i> , vagina,
<i>g.pa.</i> , genital papilla,	<i>v.d.</i> , vas deferens,
<i>i.</i> , intestine,	<i>v.dt.</i> , vitelline duct,
<i>l.</i> , lid,	<i>v.e.</i> , vas efferens,
<i>L.c.</i> , Laurer's canal,	<i>v.g.</i> , vitelline gland,
<i>m.</i> , mouth,	<i>v.s.</i> , vesicula seminalis,
<i>o.s.</i> , oral sucker,	<i>v.r.</i> , vitelline reservoir.
<i>ov.</i> , ovary,	

FIG. 1. Region of genital papilla of *Telorchis leptus* Barker and Covey, enlarged to show relations of cirrus pouch to other structures. Dorsal view.  $\times 124$ .

FIG. 2. *Telorchis angustum* Stafford, after Stafford (1900: 399, plate 26, fig. 6).  $\times 25$ .

FIG. 3. A part of a cross-section of *Telorchis leptus* Barker and Covey, taken through the genital papilla, showing relations of vas deferens to vagina.  $\times 124$ .

FIG. 4. Cross-section through the middle of the cirrus pouch.  $\times 124$ .

FIG. 5. Female reproductive organs of *Telorchis leptus* Barker and Covey. Dorsal view.  $\times 124$ .

FIG. 6. Eggs of *Telorchis leptus* Barker and Covey.  $\times 321$ .

FIG. 7. A portion of *Telorchis nematoides* (Mühl.), after Mühling (1898a: 1-118, plate 4, fig. 22) to show relations of the cirrus pouch to other organs, in the subgenera *Telorchis* and *Cercorchis*.  $\times 30$ .

FIG. 8. *Telorchis (Protenes) leptus* Barker and Covey. Dorsal view.  $\times 59$ .

